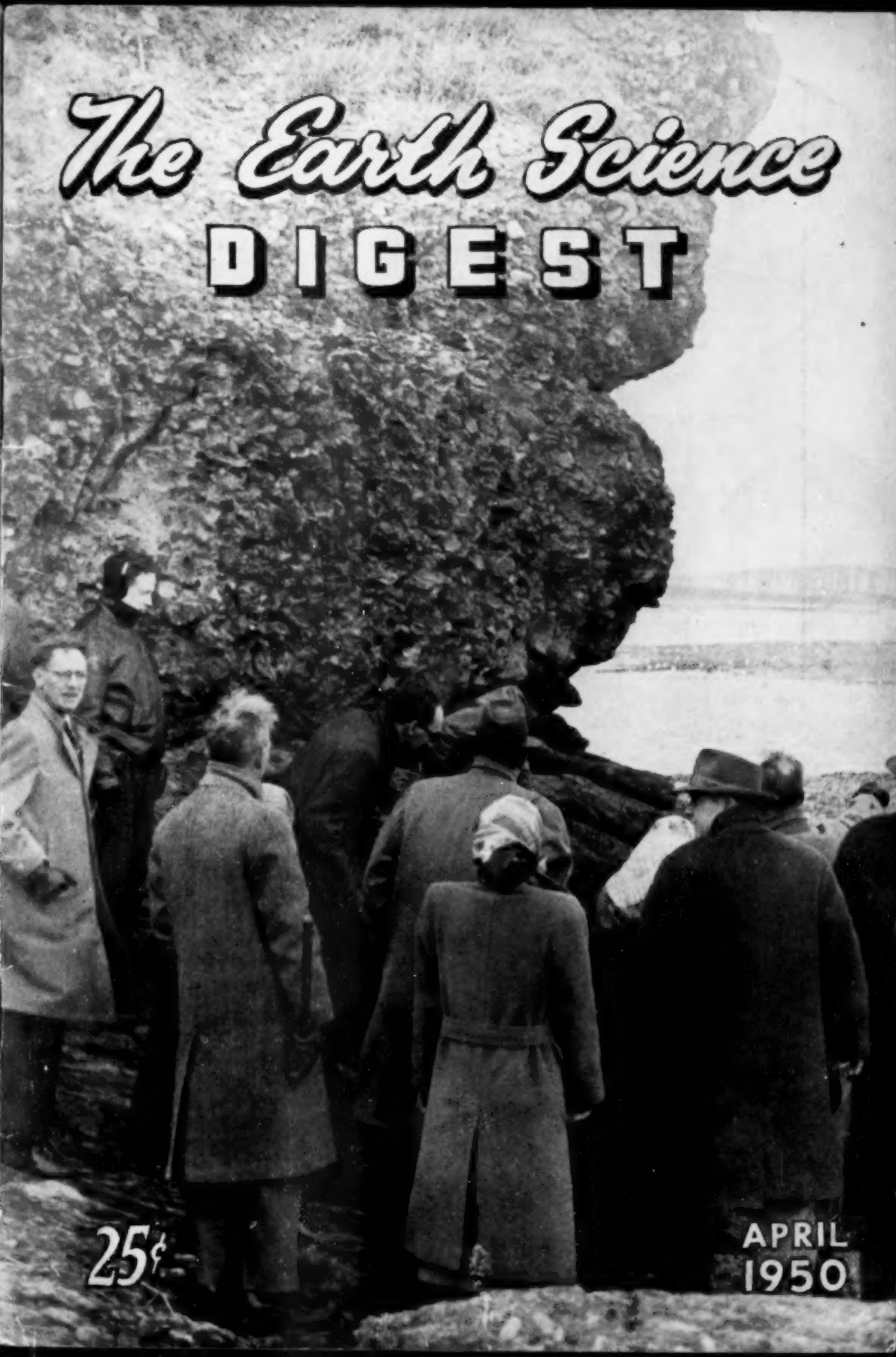
The Earth Science DIGEST



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APRIL 1950

THE EARTH SCIENCE INSTITUTE

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S. ALBERT EISENBERG, Publisher
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THE EARTH SCIENCE INSTITUTE CONFERENCE

MARCH 17-18, 1950

The second annual meeting of the Earth Science Institute was held on March 17, 1950, at Boston University. The entire slate of officers was reelected for the coming year. The **Earth Science Digest** was voted to be the official journal of the Institute. A complete report of the meeting wlil be printed in the May **Earth Science Digest.**

The Conference on the Teaching of the Earth Sciences in the Secondary Schools was a complete success, judging from the enthusiastic comments received from many of those attending the sessions. Over 100 persons attended the two-day conference. Abstracts of the papers and a summary of the discussions will be printed in the May and June issues of the **Earth Science Digest.**

AMONG THE EARTH SCIENTISTS

★ Dr. John W. Vanderwilt, consulting geologist of Denver, has been named president of the Colorado School of Mines, succeeding Dr. Ben H. Parker.

★ Dr. Robert R. Shrock has been appointed head of the department of geology at the Massachusetts Institute of Technology. Dr. Shrock, an internationally known authority on paleontology, joined the M.I.T. staff in 1937, and was appointed acting chairman of the department last year on the retirement of Dr. Warren J. Mead. Dr. Patrick M. Hurley has been named executive officer of the department. Dr. Hurley, at M.I.T. since 1938, was appointed assistant professor in 1946. Recently he has been engaged in research on the applications of nuclear science to geology with the Office of Naval Research. Dr. Frederick K. Morris, professor of geology, will retire next July. Dr. Morris, an authority on the geological structure of Asia, was professor of geology at Pei Yang University, Tientsin, China. He was a member of the Third Asiatic Expedition of the American Museum of Natural History. He became assistant professor of structural geology at M.I.T. in 1927, and was advanced to a full professorship in 1931.

★ Prof. C. O. Dunbar, Yale University; Prof. R. F. Flint, Yale University; Prof. L. C. Graton, Harvard University; and Prof. A. S. Romer, Harvard University, have been elected Foreign Members of the Geological Society of London

★ Mr. Gordon M. Stockley has been appointed Director of the Geological Survey of Tankanyika Territory. Mr. Stockley was formerly chief geologist of the Survey.

★ Dr. Robert Broom of the Transvaal Museum, Pretoria, South Africa, has been named an Honorary Member of the National Speleological Society.

Meetings and Conventions

- American Geophysical Union, Annual Meeting, May 1-4, 1950. Washington, D. C.
- International Speleological Congress. May 27-31, 1950. Monterrey, N.L., Mexico.
- Third World Petroleum Congress. May 28-June 6. The Hague, Netherland.
- Rocky Mountain Federation of Mineralogical Societies, Annual Convention. June 7-9, 1950. El Paso, Texas.
- California Federation of Mineralogical Societies, 11th Annual Convention. June 17-18, 1950. Trona, California.
- American Federation of Mineralogical Societies, 3rd Annual National Convention; Midwest Federation of Geological Societies, 9th Annual Convention, June 28-30, 1950. Milwaukee Auditorium, Milwaukee, Wisconsin.
- Wyoming Geological Association, 5th Annual Field Conference, August 9-11. Kemmerer, Wyoming.
- Northwest Federation of Mineralogical Societies, Annual Convention. Sept. 2-3, 1950. State Armory, Spokane, Wash

Cover Photo

Following the Conference on the Teaching of the Earth Sciences in the Secondary Schools, sponsored by the Earth Science Institute, March 17-18, 1950, a field trip was taken to Squantum, Mass., under the leadership of Dr. C. W. Wolfe. In this month's cover photo the famous Squantum tillite may be seen in a 40-foot wave cut cliff at Squantum Head. The rock was formerly a deposit laid down by a Carboniferous (?) glacier, some 250 million years ago. Dr. Wolfe, on the right, is seen pointing out a spit reaching toward the head from the distant island. Dr. Edmund M. Spieker, chairman of the department of geology at Ohio State University, is looking at us on the left. A temperature of 38° and gale winds accompanied the hardy participants on this trip.

GEOLOGICAL STUDIES IN THE MACKENZIE DELTA, ARCTIC CANADA

HORACE G. RICHARDS
ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA
and
UNIVERSITY OF PENNSYLVANIA

Fig. 1 — Sketch map of the Mackenzie Delta.

During the summer of 1948 I had the opportunity to make a brief trip to the Mackenzie Delta in Arctic Canada in order to make some geological investigations, particularly on the Pleistocene formations. This work was made possible by a grant from the American Philosophical Society, and a full report on the expedition has just been published in the Proceedings of that Society (Richards, 1950).

Considerable field work has been done on the Pleistocene deposits of the Eastern Arctic, and to a somewhat lesser extent on those of the Arctic coast of Alaska. However, little work had been done on the Pleistocene deposits of the Mackenzie Delta region since the Canadian Arctic Expedition of 1913-18 (O'Neill, 1924). It has been rather well established by studies in the Eastern Arctic that the land was very much depressed by the

Fig. 2 — Part of the Mackenzie River Delta as seen from a plane.

weight of the Wisconsin (late Pleistocene) ice. As the glaciers receded, the sea level rose and submerged these depressed areas. Gradually the land rose, having recovered from the weight of the ice. Traces of abandoned shore lines, frequently with extensive deposits of fossil mollusks and other marine animals, can be seen at various places along the coast of Labrador, Hudson Bay and the islands north of Hudson Bay. The elevation of these shorelines varies from a few feet above present sea level in parts of Labrador to 450 feet at Churchill on the west coast of Hudson Bay, to 898 feet in Hudson Strait, and possibly higher farther north.

Had the same history taken place in the Western Arctic, in particular in the region of the Mackenzie Delta? Several factors may have modified this history. In the first place, the Arctic Coast from the Mackenzie River westward to Bering Strait was not glaciated during the Pleistocene; consequently there is some question whether the land could have been depressed by the weight of the ice. Furthermore, the Mackenzie River, like the Mississippi, carries considerable sediment to the sea, and it is highly probable that the Delta region of the Mackenzie, like that of the Mississippi, has undergone considerable sinking since Pleistocene time, and in fact, probably is still sinking. The fact that the Mackenzie can carry sediment only a few months of the year, being frozen the remainder, would decrease the amount of sediment in comparison with that transported by the Mississippi; nevertheless, the total amount of sediment would probably be sufficient to cause considerable local subsidence.

With these various problems in mind, I left for the Arctic, travelling by train to Edmonton, Alberta, and thence by commercial air line to Aklavik, N. W. T. The air trip was fascinating as we covered in less than two days flying time a distance of almost 2000 miles, a journey which until recently had required 16 days by slow river boat.

An overnight stop was scheduled at Norman Wells, the site of the CANOL project. Owing to bad flying weather our stop was extended to two and a half days, which gave us an opportunity for an interesting visit to this oil field. Because of the abandonment of the CANOL project and the dismantlement of the pipeline to Whitehorse, some of the wells have been capped, and only enough oil is refined on the spot to take care of the needs of the Canadian North.

From Norman Wells we continued by plane "down north" to the small settlement of Aklavik, situated on an island in the Delta of the Mackenzie River, about 75 miles inland from the Arctic Ocean. This was headquarters for various collecting trips.

One trip, by chartered Piper Cub Cruiser plane, took us to Kittygazuit at the junction of the east branch of the Mackenzie River and the Arctic Ocean. While no thorough survey was possible, no Pleistocene marine sands or clays were observed on top of the bed rock in this region. The beach at Kittygazuit, opposite Richards Island, contained numerous fossil shells, probably of Cretaceous age, and it is thought that these were washed from hills inland from the beach. If Pleistocene fossils occurred anywhere in the vicinity, it is thought probable that some shells or other fossils would have been transported to the beaches, as is the case along Hudson Bay and elsewhere in the Eastern Arctic.

Deposits of ground ice or "fossil ice" (solid masses of ice in the permanently frozen ground) were noted along the coast northeast of Kittygazuit. Some of this ice may actually date from the Pleistocene.

Another plane trip took us over the western edge of the Delta and over the drift ice of the Arctic Ocean to Herschel Island, some 150 miles northwest of Aklavik and opposite the mouth of the Firth River. This island had formerly been an important whaling station, but had been abandoned for the past fourteen years until the reopening of the R.C.M.P. barracks a few weeks prior to our visit. Other than a few Eskimo families the two "mounties" were the only inhabitants of the island and consequently were very glad to welcome us as visitors.

Some years ago O'Neill had collected Pleistocene fossils from the bluffs along the shore of this island, and fortunately we were able to relocate these bluffs and to collect a number of interesting specimens. These fossils indicated brackish water and suggested that during the Pleistocene, as today, the freshwaters of the Mackenzie River had a decided diluting effect on the salt water of the Arctic Ocean.

An attempt was also made to find Pleistocene marine fossils west of the Delta, but as was the case near Kittygazuit, only Cretaceous fossils were found. The best locality for these fossils was Black Mountain, near Husky Channel, some 35 miles west of Aklavik.

We returned home by a different route, flying first to Dawson and Whitehorse, and then back to Edmonton, flying approximately over the route of the Alcan Highway.

While the expedition was very brief and we brought back only a relatively small number of fossils, we were able to reach a few tentative conclusions, among which were the following:

1. There is no evidence of a Pleistocene marine submergence in

Fig. 3 — Ground ice near Kittygazuit, Northwest Territories.

the immediate vicinity of the Mackenzie Delta.

2. Pleistocene marine fossils were found west of the Delta, notably on Herschel Island.

3. The Arctic Coast from the Mackenzie River westward to Bering Strait was unglaciated during the Pleistocene, and consequently there was little or no subsidence of the land due to the weight of the ice.

4. Any postglacial rise of the land in the immediate vicinity of the Mackenzie Delta would probably have been counteracted by a subsidence caused by the sediments carried down by the Mackenzie River.

5. The Pleistocene fossils from Herschel Island may indicate a slight change in the relative position of sea and land. However, this change is minor compared with those of the Eastern Arctic. Herschel Island is probably far enough west of the Mackenzie River to escape the major effects of local subsidence caused by the sediment carried north by that river.

6. The possibility of earth movements caused by factors other than the weight of the ice, or weight of the Mackenzie sediments, cannot be entirely ignored.

REFERENCES

O'NEILL, J. J. 1924. The Geology of the Arctic Coast of Canada west of the Kent Peninsula. Rept. Canadian Arctic Exped. 1913-1918. Vol. 11, Part A.

RICHARDS, HORACE G. 1950. Postglacial Marine Submergence of Arctic North America with special reference to the Mackenzie Delta. Proc. Amer. Philos. Soc. Vol. 94, pp. 31-37.

News From the U. S. Geological Survey

The talc deposits at the Mad River Mine near Fayston, the Rousseau prospect near Cambridge, and the Carleton quarry near Chester, all in Vermont, were geologically mapped by Dr. Marland P. Billings of Harvard University and Alfred H. Chidester of the U. S. G. S. Copies of the maps (Strategic Minerals Investigations, Preliminary Maps 3-227) may be obtained without cost upon application to the Director, U. S. Geological Survey, Washington, D. C.

Paul H. Jones, geologist in charge of ground-water investigations for the U. S. G. S. in Louisiana, has arrived in Chile to aid that government in a study of underground waters affecting a major irrigation project.

At the request of the Government of India, John Van N. Dorr II, U. S. G. S. geologist, has reported at New Delhi to conduct studies of mineral resources in the Province of Orissa. Mr. Dorr will advise the Indian Geological Survey as to what geophysical studies, diamond-drilling, or further geologic investigations may be required before actual drilling of known deposits is begun. During the war he was chief of the Foreign Geology Section of the U. S. G. S. Since the war he has been in charge of the Survey's mission in Brazil on a project mapping 4,000 square miles of an area rich in iron and manganese.

Dr. Glen F. Brown, U. S. G. S. geologist, has left Bangkok, Thailand, enroute to Jidda, Saudi Arabia, to conduct a country-wide water survey at the request of the Saudi Arabian government. He will gather information on the location of potential as well as available water sources, both surficial and below ground. Dr. Brown had been with the Thailand mission for the last six months, along with Dr. William D. Johnston, Jr., Chief of the Survey's Alaskan and Foreign Geology Branch.

A new map of the Crawford Notch area in New Hampshire's White Mountains, based on the 1946 standard, contoured topographic map, but with relief shown by shading, has been issued by the U. S. G. S. and is available at twenty cents a copy. It is designed to show the physical features of the area in three dimensions. The bolder topographic features are portrayed both in precise location and in physical character. An illusion of height for the hills and slope for the valleys is obtained by use of an air brush to show lights and shadows.

George C. Taylor, Jr., U. S. G. S. geologist, has been detailed to New Delhi, India, to confer with officials of the Central Government and the Geological Survey of India on that country's ground water problems. His special field is ground water geology and geomorphology.

A report on the photo-interpretation of terrain along the southern part of the Alaska Highway, recently completed under the direction of the U. S. G. S., has been placed on open file, and is available for public inspection at Room 1033 (Library), U. S. G. S., General Services Bldg., Washington. The study, which applies the combined knowledge and techniques of both geology and botany to the photo-interpretation of terrain in northern regions, was made by Dr. H. M. Raup of Harvard University and Dr. C. S. Denny, Survey field geologist. The report has been prepared for publication as a part of the terrain studies of the Geology Branch of the U. S. G. S.

A GUIDE TO PROSPECTING FOR LODE GOLD

E. D. GARDNER
United States Bureau of Mines, Washington, D. C.

Interest in gold mining and prospecting for gold remains steady. From time to time many people take to the field to search for new gold deposits. A large percentage of them have had no previous experience in prospecting for lode gold; this paper has been written with the hope that it might assist these newcomers.

Prospecting

A majority of the metal mines in the United States have been discovered by qualified prospectors who were searching for valuable minerals at the time. Chance, however, always has played a large part in finding mineral deposits. Some of the discoveries of the past were made by men on other errands, such as rounding up burros or hunting game. Accidental discoveries of ore bodies have been made in building roads and trails and in exacavating for mine structures. Evidence of ore has been brought to the surface by burrowing animals and by ants; gold found in the craws of fowl has led to discoveries of deposits. Important discoveries have been made by men who had no knowledge of rocks or minerals; on the other hand, many ore bodies have been found by experienced prospectors, sometimes after hundreds of untrained men had already passed over the ground.

The prospector who carries on his work diligently and intelligently is of course more likely to be rewarded for his efforts than the lazy or untelligent worker; nevertheless, it is obvious that if valuable deposits are not present at the place being prospected none will be found. Conscientious and painstaking efforts to trace gold to its source usually disclose nothing more valuable than some narrow, unworkable seams; however, many deposits that were developed into profitable mines were found by this method of prospecting. Although some prospectors have made several lucky strikes, many others have spent their working lives searching for gold without finding anything worth while. Probably only one prospector out of several thousand ever finds anything worth developing. Moreover, only 1 out of every 300 or 400 properties developed becomes a profitable mine.

Prospecting was begun in the Western States in the fifties as the miners looked for the source of gold found in placers. The search for gold has been continuous since that time; the number of prospectors in the field at any one time, however, has varied greatly. Except in some desert regions, practically all of the placer fields now being worked were discovered by old timers; moreover, most of the important gold districts were found by early prospectors. Important discoveries of lode mines, however, have been made from time to time. Most of the area in the mining regions of the West has been searched many times by prospectors, and nearly all of the easily found deposits have been located, but it is reasonable to expect that new gold mines will continue to be found. Most of the future discoveries undoubtedly will be of deposits that do not outcrop. Prospecting for such deposits requires considerable digging.

Several important discoveries were made in 1934. One of these, the Rogers-Gentry gold mine at the edge of Antelope Valley in Los Angeles County, Calif., was found by an experienced prospector on an old patented homestead a number of miles from the nearest producing mine. The initial discovery at this mine was an iron-stained, decomposed, siliceous limestone outcrop, with no vein structure evident at the surface, near a small, barren quartz outcrop and a water seep. Another discovery, the Silver Queen gold mine, in the same general region and near Mojave, Calif., was found by an experienced miner on an open fraction 400 to 1,400 feet in size between two old properties that were thought to have been worked out years ago. The Silver Queen discovery was made as the result of finding a simple piece of float unlike any ore in the region. The vein did not outcrop; the discovery point was under 6 feet of cover.

To prospect for lode gold, the miner should know first of all how to take care of himself in the hills or on the desert. He should be physically able to stand hard work and know how to use a pick and shovel. Most prospectors also have occasion to drill holes by hand and should know how to use explosives. To prospect for lode gold intelligently, one should be able to identify gold and the minerals usually associated with it, besides being able to distinguish one general class of rock from another.

Most prospectors work alone and are accustomed to solitude. As discoveries that can be sold for cash are few and far between, prospectors must have some other resources for subsistence. Many prospectors work in mines in the winter and prospect in the summer. Others do the assessment on claims for owners to earn enough money to buy supplies for prospecting. In the old days, many prospectors were grub-staked by merchants, individuals, groups of individuals, or companies, usually on a 50-50 basis. The practice now is followed less than formerly, but a professional prospector of good repute usually can get a backer.

Favorable Areas

Although the old saying that "Gold is where you find it" is quite true, the probability of finding gold in paying quantities will be increased greatly if prospecting is done in areas geologically favorable for the occurrence of gold. Regions in which gold is known to occur naturally are more favorable for prospecting than those where no gold has ever been produced.

The important known gold deposits in the United States occur in regions where intense igneous activity has occurred at some time. The most promising fields for finding new deposits of gold, therefore, should be in or near igneous rocks. Not all igneous formations, however, are favorable for the deposition of gold. It probably would be a waste of time to prospect in dark lava flows. Large masses of granites or related coarse-grained crystalline igneous rocks are unlikely to contain gold deposits unless cut by dikes or other intrusions of finer-grained and usually light-color igneous rocks, such as porphyry, rhyolite, or andesite.

Areas are favorable for prospecting where the principal rocks are granites (as suggested above), schists, slates, greenstones, or related rocks cut by later intrusives. Areas in which the principal rocks are the light-color, finer-grained igneous rocks, especially if of several varieties, are also favorable.

One of the most favorable areas for the occurrence of gold is where the country rock is made up of surface flows, sills, dikes, and other intrusions of these light-color igneous rocks.

Profitable gold deposits sometimes are found around the borders of great masses of granitic rocks, both in the granites and in the surrounding rocks, but more often in the latter.

Large areas of sedimentary rocks, such as shale, sandstone, and limestone, are unfavorable for prospecting unless the sediments are cut by the light-color intrusions previously mentioned; and even where so cut the sedimentary areas seldom contain workable quantities of gold unless they have been metamorphosed (changed by pressure and heat) to slate, quartzite, or marble.

Gold Lodes and Ore Shoots

Gold in paying quantities does not exist indiscriminately in country rock but where it has been deposited in definite zones usually termed "lodes." Solutions containing the gold have arisen from great depths and have been deposited by relief of pressure, cooling of the solutions, or other causes. For a lode deposit to have been formed, there must therefore be some form of opening or zon of weakness through the rocks along which the solutions may rise. Earth movement or faulting commonly causes zones of weakness. Therefore, in prospecting it is well to keep a look-out for fracturing.

Parts of the lodes that contain gold in large enough quantity to be ore (that is, material that can be mined at a profit) are called "ore shoots." Shoots seldom extend between walls but may be confined to a relatively narrow streak or streaks. Gold-ore shoots usually are relatively small. After a gold-bearing lode is located, considerable work may be necessary to find an ore shoot; frequently the gold will not occur in sufficient quantity for any part of the lode to be worked profitably.

The simplest and most common form of gold lode is what is termed a "true fissure vein" by the miners. Fracturing, with or without faulting, has occurred in a relatively narrow zone with well-defined walls. The ore minerals have been deposited in this zone and may fill the space between walls completely. Usually, however, fractured country rock and, if the movement has been great, gangue or slickensides occupy part of the space.

Another type of lode is the shear zone. Here the walls usually are not well-defined. The ore-bearing solutions have deposited the gold and associated minerals in the cracks made by the fracturing. If present, ore shoots may occur anywhere in the fractured zone. Uusually they overlap and occasionally may be parallel.

The contact between two different kind of rocks, especially an igneous rock and something else as schist, is generally a line of weakness. Ore-bearing solutions may have been able to rise along the places of weakness and form ore bodies. Such a lode is called a contact vein. Gold ore also may occur in bedded sedimentaries where a fissure cuts a contact, particularly between limestone and quartzite, where conditions are otherwise favorable geologically for the deposition of ore.

Searching for Gold Deposits

In looking for gold deposits vein or lode outcrops are sought and when found are examined for gold-bearing material. Portions of the veins have been eroded away; on steep hills part of the outcrops may have broken off and rolled down the hillside. Mineral-bearing fragments of vein material are called "float". Many deposits have been found by tracing float to its source. In prospecting, a look-out always is kept for such material. Float in the gravels of large streams may have come many miles. In such instances the presence of the float indicates only that the gold-bearing material exists in the watershed above. Where float is found on a hillside, the fragments are sought upward until no more are found. If the surface is covered with overburden trenching will be necessary to disclose the lead.

Lodes also may be located by panning loose material below for free gold. Placers are formed from disintegration of rock containing gold. During the ages gold lodes are eroded away at the surface, the gold-bearing rock is ground to powder, and the gold is concentrated in stream beds or desert deposits. The gold of rich placers, however, may have come from a multitude of narrow or low-grade streaks that could not be worked at a profit. The presence of placer gold in a stream bed indicates that the region above contains or has contained lode gold. In seeking for lodes in such a region, the gravel of stream beds or debris of dry washes is panned to trace the gold to its source. If the gold suddenly plays out in the main watercourse, attention then is directed to the side gulches, which in turn are followed up until no more placer gold is found. The debris on the mountainsides is then panned and the gold traced to its source. At this stage of prospecting, float in the overburden may help in the search or be the key to the source of the gold.

Occasionally rich accumulations, called pockets, of free gold are found in the hillside debris. Especially in California pocket hunters have made a living by searching out these accumulations. The same procedure is followed, whether the search is for a lode or a pocket. Valuable deposits in place have been found by pocket hunters.

As placer gold travels from its source it becomes flattened or rounded. Angular or jagged gold usually has not traveled far. The same is true of float. Well-rounded fragments of vein quartz may have traveled far, while angular pieces are not likely to have been transported a great distance. In flat, glaciated country, float or free gold may have come hundreds of miles and may signify nothing as far as the immediate region is concerned.

Quartz, usually a constituent of gold ores, is hard and resistant to weathering. Furthermore, mineralization of a vein frequently is accompanied by silicification of the vein filling and the immediate wall rock, which increases the resistance to weathering and erosion. Hence, a majority of veins containing gold ores outcrop above the surrounding surface. In flat regions, however, the outcrops above may be covered with overburden brought down by floods. In some instances the vein may be badly fractured; any quartz present may be in narrow seams in a gangue of shattered country rock. When this is the case the vein at the surface may be softer than the adjoining wall rock and cause a depression. Trenching, therefore, is necessary to disclose the lode in place.

In searching for a hidden vein the following features which may be caused by the existence of a lode should be noted:*

1. A natural trench or ditch that does not run directly down the slope of the hill or mountain.
2. A sudden change of slope.
3. A sharp notch that crosses a ridge that has a rather uniform altitude on both sides of the notch.
4. Several springs in a line.
5. A sudden change in the kind or quantity of vegetation (may indicate a contact or, if the change in vegetation is found over a narrow strip of ground, a lode may be beneath).

Although many other possible causes may be responsible for these structural features, some trenching would be justified if float was found immediately below and not above any particular one of them.

Iron sulfides, which frequently are associated with gold, oxidize to red or yellow oxides when exposed to the surface elements. The presence of a lode very often is disclosed by the stain of these iron minerals.

Present-day prospectors examine old cuts or other workings on abandoned claims. With the improvements in metallurgy since the original work was done, material passed up by the old timers may now be valuable.

*Butler, G. M., Some Hints on Prospecting for Gold; Arizona Lode Gold Mines and Gold Mining: Bull. Univ. of Arizona, Tucson, Ariz., vol. 6, p. 251.

With a few notable exceptions, the gold in lode deposits occurs as the native metal. At Cripple Creek and some of the other Colorado districts the gold is a constituent of telluride minerals; in general appearance, these minerals resemble the iron sulfide minerals.

Gold and Associated Minerals

Gold can be identified readily by sight. It is the only soft, yellow substance with a metallic luster occurring in nature. It can be flattened easily without breaking and be cut or scratched readily with a knife. It is sometimes confused with pyrite, chalcopyrite, or other sulfides or with plates of yellow mica. Pyrite is too hard to be scratched with a knife, and sulfides that resemble gold crush into black powder. Yellow mica yields a white powder when scratched with the point of a knife. When any doubt exists, the suspected substance ordinarily is not gold.

The principal gangue mineral in gold deposits usually is quartz. This mineral is distributed widely in mineralized areas, but a very small percentage of it will be found to contain gold. Glassy or what is called "bull quartz" by the miners seldom if ever is gold-bearing. Massive quartz leads may be very persistent but generally are barren, except in some cases where secondary quartz with more of a porcelain appearance has been deposited. In the Mother Lode region of California the gold usually is associated with this secondary quartz.

With a few exceptions, gold below the zone of oxidization generally is associated with or accompanied by sulfides. The principal sulfide ordinarily is pyrite; in some cases, however, chalcopyrite, arsenopyrite, or galena may be the important gold carrier. Gold may occur, however, in quartz without the associated sulfides or their oxidization products or in veins where quartz is not important. For example, in the Oatman (Ariz.) district all gold is free, and the principal gangue mined is calcite.

Iron streaks or vugs (cavities, usually lined with a crystalline incrustation) in quartz-lead matter are promising places for native gold to occur. Frequently if present it can be seen by the naked eye or with a glass, therefore the prospector is on the look-out for iron-stained or honey-combed quartz. Outcrops, consisting mainly of iron oxides or lead matter heavily impregnated with iron (called gossan), when found in a mineralized region always should be tested for gold; the gossan may be at the top of copper or lead ore bodies with the latter two metals leached out. Sometimes the gossan carries paying mounts of gold.

Any outcrop or float of iron-stained, fractured, light-color, igneous rock recemented with silica or showing evidence of silicification and banding should be investigated. The ore of the Silver Queen mine near Mojave, Calif., is of this latter type.

In glaciated regions and occasionally elsewhere sulfides occur at the surface. Moreover, float containing sulfides occasionally is found. Both outcrops and float usually are tested for gold by the prospector. Frequently the outcrop of a lead* is shown by green or blue copper stain. Should the original copper sulfide have been associated with gold the possibility of a deposit of gold ore exists.

Prospectors usually do not confine their efforts to the search for gold but will locate any deposit that promises to be of value, irrespective of the kind of contained mineral. To be present in sufficient quantities for the material to have value as an ore, the base metals must occur in amounts readily discernible by the eye; the base metals, however, may have been removed from outcrops by leaching.

Sampling and Panning

As mentioned before, gold occasionally is visible in vugs or high-grade seams, but usually the gold in its ores is not visible either to the naked eye or with a glass. Rock suspected of containing gold may be tested by assaying or panning. Of course, the former method is to be preferred, but the cost ($1 to $1.50 per determination) precludes its general use by most prospectors. Some of the large mining and smelting companies, however, will assay free a reasonable number of samples sent in by bona fide prospectors. In this way they may be the first to learn of new discoveries.

Gold prospectors make a practice of panning (or horning) likely looking rock. The sample is first ground in a mortar or otherwise pounded into powder. A small, cheap frying plan appears to be preferred by most prospectors for panning rock samples. Although the greater reliability of relatively large samples is realized, most prospectors when grinding the rock by hand and panning in the field use 1- or 2-ounce samples. In prospecting, the best-looking material is panned. After the rock has been shown to contain gold the value per ton should be ascertained by assaying. Samples for

*Commonly used as a synonym for ledge or lode. Many mining-location notices describe the locator's claim as extending a certain number of feet along and so many feet on each side of the "lode, lead, vein, or ledge." The word is pronounced "leed" and should not be confused with the metal lead.

assaying should be cut over a definite width of the exposed vein.

A competent panner can estimate fairly closely the gold content of ore with which he is familiar. An expert panner with a 1-ounce sample can detect gold in rock that will assay only about 0.02 ounce of free gold per ton. A milligram of gold in an assay ton (29.-168 grams) indicates 1 ounce of gold per ton of 2,000 pounds. An ounce avoirdupois is 28.350 grams.

Not all gold-bearing rock pans. Where the gold is associated with or contained in sulfides, grinding in a mortar may not liberate enough of the gold to be detected in the pan. In the United States, however, the gold in outcrops usually has been liberated by oxidization to such an extent that it can be panned.

In searching for gold, most professional prospectors carry a mortar and a canteen of water. Likely looking rock is panned as found. By this procedure a load of rock is not accumulated, and many samples are tested that would not be carried to camp. Furthermore, there is no confusion regarding location of the gold-bearing material, as often is the case when samples are accumulated.

Although an experienced man may identify gold tellurides in the ore or in the pan the sample should be assayed when their presence is suspected. Assays also are of course necessary to tell whether sulfides contain gold.

All major exposures of veins or other structures that appear favorable for the occurrence of gold should be sampled and assayed. No one should be shipped without being assayed; almost invariably the shipper is disappointed when this is done. As mentioned above, samples should be cut across definite widths of the vein. Hand and grab samples of ore to be shipped are almost always high.

Surface Weathering

Weathering and leaching by surface solutions may remove the base metals from surface outcrops. Gold, however, is very resistant to leaching, and weathering of the iron and associated minerals may increase the value per ton of surface ore; hence, it cannot be expected that the value of gold deposits will increase with depth. Usually the contrary is true.

Prospecting on Patented Ground

Prospectors are reluctant to prospect on patented ground, as anything found would belong to the owners of the land. The author believes, however, that opportunities occur for finding new deposits on some of the thousands of idle patented mining claims held throughout the West. Many of these claims are held by estates. Even where the owners of idle claims would be willing to draw up papers to the effect that a discoverer of new ore would benefit from his findings, the average prospector would decline to go to this trouble and conduct his searches elsewhere.

Prospecting Outfits and Provisions

The outfit to be taken on a prospecting trip depends upon the mode of transportation, work contemplated, and the funds available. Enough equipment should be taken, but unecessary articles make extra work. When a more or less permanent camp is established, added equipment for personal comfort and efficiency can be obtained. Usually a cabin is built for a permanent camp.*

*Gardner, E. D., and Johnson C. H., Placer Mining in the Western United States. Part I — Prospecting Outfits and Provisions: Inf. Circ. 6786, Bureau of Mines, 1934, 73 pp.

Reprinted in part from Bureau of Mines Information Circular 7535 (Feb. 1950).

Geiger Counters Will Help Find New Oil Pools

OAK RIDGE, Tenn., March 17 (Science Service) — Geiger and other radiation counters may soon be standard equipment for searching out new pools of oil. Possibility of the use of radiation detectors in hunting oil was discussed here at the meeting of the American Physical Society. Drs. Clark Goodman, Charles W. Tittle and Henry Faul developed this application while working at the Massachusetts Institute of Technology.

They found that the penetration of solid materials by neutrons and gamma rays gave an index of the structure and composition of the surrounding cased drill holes. Counters can be used to detect the radiation from formations near these holes.

They also found that when a portable neutron source was lowered into well casings, the neutrons caused gamma rays to be emitted from the surroundings. These rays can likewise be measured to indicate the structure of surrounding formations.

When measurements of the amount of radiation are made at the same time at several points along the axis of a drill hole near a porous formation, they can be used to tell whether the formation contains oil or water, either salt or fresh. These measurements can also indicate the efficiency of other techniques now used to locate oil reservoirs.

★ Due to the continued rise in printing costs, we are forced to raise our subscription rates. The following rates will be in effect August 1, 1950: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Foreign: 1 year, $3.50; 2 years, $6.00. Special group subscription rates (allowed to educational institutions and societies): 10 or more subscriptions, $2.00 each per year. By sending in your renewal **now**, regardless of whether your subscription is expiring, you may take advantage of the savings. A 3-year subscription or renewal is now only $5.00, or less than 14¢ a copy — a saving of $2.00. With your full support we hope to offset this increase by another increase — in the number of pages and new features.

★ Among the recent group subscribers to the Earth Science Digest are the Foot & Hangingwall Society, Copper Cliff, Ontario, and the Salem (Oregon) Geological Society. Our special group subscription rate will be raised from $1.50 to $2.00, when the subscription rates change on August 1, 1950. Take advantage of these savings now — tell your society secretary or department chairman to write for details.

★ M. Robert de Joly, President of the Sociète Spèlèologique de France, will attend the International Speleological Congress in Monterrey, Mexico, and plans to do some caving in the United States.

★ The following new project grants have been announced by the Geological Society of America: Dr. J. Harlan Johnson, Colorado School of Mines, will study types of fossil coralline algae in museums abroad. Mr. Kazuo Kuroda will study the distribution of fluorine and chlorine in igneous rocks. Dr. J. Laurence Kulp, Columbia University, will establish a Strontium Isotope Method to measure the age of sedimentary and metamorphic rocks.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

SEISMOLOGY

EARTHQUAKES IN NORTH AMERICA. B. Gutenberg. **Science**, Vol. 111, No. 2883 (March 31, 1950), pp. 319-324. A history of the progress of seismological research, particularly in North America. The results of investigations of earthquakes are based upon the material in **Seismicity of the Earth** by Gutenberg & Richter (1949).

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THE T PHASE OF SHALLOW-FOCUS EARTHQUAKES. Ivan Tolstoy & Maurice Ewing. **Seismol. Soc. Am. Bull.**, Vol. 40, No. 1 (Jan. 1950), pp. 25-51. A short-period phase, 0.5 sec. period or less, traveling through the ocean with the velocity of sound in water has been identified on a large number of seismograms of earthquakes occurring at sea. The mechanism of this T phase is discussed. Only shocks of magnitude 7 or over produce small-amplitude T phases.

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PROPOSED USE OF THE T PHASE IN TSUNAMI WARNING SYSTEMS. M. Ewing, Ivan Tolstoy & Frank Press. **Seismol. Soc. Am. Bull.**, Vol. 40, No. 1 Jan. 1950), pp. 53-58. A striking correlation has been found between the occurrence of a T phase and the occurrence of tsunamis (seismic sea waves, often of great size). The evidence at hand warrants the inclusion of instruments suitable for recording the T phase in tsunami warning systems. SOFAR listening stations might be used since they offer the best means of recording the T phase.

PETROLOGY

GLACIAL VARVED CONCRETIONS OF NEW ENGLAND. Ray S. Bassler. **Smithsonian Inst. Ann. Rept. 1948** (1949), pp. 269-276. In this interesting study of glacial varved clay concretions, an account is given of the discovery of clay concretions exposed as the result of a landslide by the people of Kennebunk, Maine, in 1670. 12 plates of concretions from Ryegate, Vermont, are shown. This concretion formation is due to the presence of foreign substances such as clay during the attempted crystallization of calcite in clay, in which lateral accretion predominates because of the easier movement in the clay particles among the bedding planes.

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TURBIDITY CURRENTS AS A CAUSE OF GRADED BEDDING. Ph. H. Kuenen & C. I. Migliorini. **Jour. Geology**, Vol. 58, No. 2 (March 1950), pp. 91-127. The authors believe that turbidity currents of high density may be invoked to have supplied the sediment and deposited it in those types of graded bedding whcih cannot readily be accounted for by normal processes of sedimentation (volcanic eruptions, dust storms, climatic rhythms, rejuvenation of relief at the source or filling in of the sedimentary basin, churning up of sediment by storm waves). Experimental investigations on the nature of turbidity currents and the production of graded bedding are described in detail.

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THE JADEITE PROBLEM. Part I. Hatten S. Yoder, Jr. **Am. Jour. Sci.**, Vol. 248, No. 4 (April 1950), pp. 225-248. The probable stability range of jadeite is defined. Jadeite occurs in Burma, Japan, and in Central America. All attempts to synthesize it have been unsuccessful. A new analysis is given. The jadeite problem is considered to be distinct from the eclogite (a schistose metamorphic rock consisting of light-green pyroxene, actinolite, and garnet) problem.

PLEISTOCENE GEOLOGY

EVIDENCE FOR PLEISTOCENE MAN IN SOUTHERN CALIFORNIA. George F. Carter. **Geographical Review,** Vol. 40, No. 1 (Jan. 1950), pp. 84-102. Exposed in the truncated seaward face of an alluvial fan near the sea shore at La Jolla, Calif., is evidence of Pleistocene man. Granite cobbles, one being a plano-convex mano, were found at a depth of five feet. The estimated age is about 40,000 years ago.

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THE PLEISTOCENE HISTORY OF THE MISSISSIPPI RIVER. William H. Hobbs. **Science,** Vol. 111, No. 2880 (March 10, 1950), pp. 260-262. About half of the course of the river flows through an area that was invaded by the lobes of four continental glaciers. The first three caused a large displacement of the river. Maps of the river channel are presented for each of the four stages of the Pleistocene.

PHYSICAL GEOLOGY

THE CAROLINA "BAYS". Frank A. Melton. **Jour. Geology,** Vol. 58, No. 2 (March 1950), pp. 128-134. Inasmuch as the area of assumed outflow of ground water must be the same as the area of intake, D. W. Johnson's theory of origin of the Carolina "bays" would violate the laws of conservation of energy. Other errors and illogical theory in Johnson's spring vent hypothesis are pointed out. It is shown through a revision of the meteoritic theory that the supposed impact could have occurred at any one of several times.

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VARIATIONS IN HISTORY OF CONTINENTAL SHELVES. Paul Weaver. **Am. Assoc.** Petroleum Geologists Bull., Vol. 34, No. 3 (March 1950), pp. 351-360. The theory is presented that the shore line which bounds the shelf toward the land is not the locus of any movement, the continental shelf and the adjacent land differing only because of different erosive agencies. The significant tectonic zone is at the outer edge of the continental shelf.

ECONOMIC GEOLOGY

GOLD AND SILVER CONTENT OF SOME TREES AND HORSETAILS IN BRITISH COLUMBIA. Harry V. Warren & Robert E. Delavault. **Geol. Soc. Am. Bull.,** Vol. 61, No. 2 (Feb. 1950), pp. 123-128. In an area known to contain many gold-bearing veinlets, with overburden usually ranging from 4 to 8 feet in depth, samples from five species of trees were taken. Collection of horsetails were made from near-by ground containing more modest quantities of gold. Analyses revealed gold in every sample but one. The gold content of the ash was as high as 1.02 p.p.m. (parts per million); of the dry plant material, up to 0.075 p.p.m. The plants contained up to 30 p.p.m of silver in the ash; and 1.40 p.p.m. in the dry plant material. Control samples from non-gold-bearing areas with similar climate in no instance provided weighable quantities of gold. Silver was found in most plants in both silver-bearing and non-silver-bearing areas.

MISCELLANEOUS

AFRICAN ELEPHANTS AS GEOLOGICAL INDICATORS. Herbert P. T. Hyde. **Nature,** Vol. 165, No. 4191 (Feb. 25, 1950), p. 326. The author has observed that elephants appear to show preference for certain geological horizons, at times so well pronounced that the boundary line between two formations may be deduced from native information as to how far the elephants circulate in the district, particularly where crystalline rocks, mainly granite masses, come into contact with sandstone. The elephants prefer the sandstone, probably because its decomposition gives rise to dense vegetation; or else it might be a matter of food, chemical composition of water, or nature of the weathering soil.

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ALGAL PILLARS MISCALLED GEYSER CONES. Roland W. Brown. **Smithsonian Inst. Ann. Rept. 1948** (1949), pp. 277-282. Algal pillars, near Rock Springs and Green River, Wyoming, have been miscalled geyser cones due to their vertical, hollow structures resembling those developed at the vents of hot springs and geysers. The inner zone may consist of chalcedony, sometimes with quartz or calcite crystals projecting inward. The outer zone consists of thin layers of lime deposited one upon the other.

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QUARTZ CRYSTALS WITH CLAY AND FLUID INCLUSIONS. Stephen Taber. **Jour. Geology.** Vol. 58, No. 1 (Jan. 1950), pp. 37-48. Fluid and red-clay inclusions are found in quartz crystals from the upper Piedmont of North Carolina. It is concluded that the soil in this area was not subjected to deep freezing during glacial stages, for crystals with large inclusions of water, which can be shattered by freezing, are found close to the surface in places that have undergone practically no erosion since the Pleistocene.

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THE AGE OF THE EARTH. Arthur Holmes. **Smithsonian Inst. Ann. Rept. 1948.** (1949), pp. 227-240. The earth is estimated to be 3,350 million years old, based on the isotopic constitution of rock-lead. The most widely favored estimate is 2,000 million years. By a curious coincidence, the ancient Hindus believed that we are now in the 7th of the 14 great cycles of the Day of Brahma, and, according to the Hindu calendar, it is now (A. D. 1950) 1,972,949,051 years since the earth came into existence. An account of the historical progress of the geologists' estimations of the age of the earth, and of the methods of lead isotope analysis is presented.

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WOLF CREEK METEORITE CRATER, WESTERN AUSTRALIA. D. J. Guppy & R. S. Matheson. **Jour. Geology.** Vol. 58, No. 1 (Jan. 1950), pp. 30-36. The Wolf Creek meteorite crater in Western Australia, discovered in 1947, is the second largest known meteorite crater on the earth's surface. It is 2,800 feet wide and 170 feet deep, as compared to the 3,900-foot width and 570-foot depth of Meteor Crater, Ariz. There is very little erosion and the walls are steep. Evidence suggests that it was formed later than Miocene times, and is probably Pleistocene or Recent. Fragments of meteoritic iron were found around the 90-foot rim of the crater.

★ At the last Council meeting of the Mineralogical Society of America, it was voted to establish the Mineralogical Society of America Award (temporary name) — a life membership in the society. The award shall be given for an outstanding contribution of original research published and made during the three years prior to selection by the Council. The work must have been accomplished at an age of 35 years or less, and will be made without regard to nationality. Membership in the society is not a necessary prerequisite.

THE DIVINING RODS OF SCIENCE

[PART TWO OF A SERIES DEALING WITH GEOPHYSICAL EXPLORATION]

CHARLES A. WILKINS

II. – MAGNETIC METHODS

Paramagnetism and Diamagnetism

The magnetic properties of certain ores were the first to be utilized in applying instruments to their discovery. All metals (in fact, all forms of matter) are subject to magnetic force, as well as gravitational pull. However, different metals respond quite differently when placed in a magnetic field and they are divided into two groups, according to whether they are **paramagnetic** or **diamagnetic.** Paramagnetic metals, such as iron, steel, nickel, etc., are attracted by the magnet, and if suspended so as to swing freely between the poles of a magnet, will arrange themselves so that their longest axis is in line with the two poles. Gold, silver, copper, lead, etc., are diamagnetic, and are repelled by the magnet. If suspended in a strong magnetic field, they tend to turn their longest axis to a position that is at right angles to the lines of force. Diamagnetism is a comparatively weak property, and delicate instruments are necessary to measure its intensity. For this reason, magnetic methods employed at present cannot be used in discovering diamagnetic metals unless such metals happen to be associated with the paramagnetics, as is often the case with gold and platinum, which usually have iron associated with them.

The Magnetic Method vs. The Gravitational Method

In common with gravitational methods, magnetic prospecting utilizes a natural and spontaneous field of force, with fields of geologic bodies superimposed upon a normal terrestrial field. Coulomb's law, which controls the attraction of magnetic bodies, is identical in form with Newton's law of gravity; both gravitational and magnetic methods observe the integral effects of all bodies within range, and lack depth control (no way to find the depth of the magnetic body in the application of the exploratory device itself; geological knowledge of the sector under investigation must be applied to determine depth when possible.) One important difference is that gravitational fields of geologic bodies do not depend on the earth's gravitational field, whereas magnetic bodies frequently owe their magnetization to the magnetic field of the earth. For this reason, magnetic anomalies* are often subject to change with latitude. Moreover, rocks may have magnetism of their own, whose direction may or may not coincide with that induced by the terrestrial magnetic field. An important factor in the interpretation of magnetic methods is that rock

*Magnetic irregularities.

magnetism, contrary to rock density, is of a bipolar nature.

In gravity methods, total field vector and the horizontal gradients of the vector or of its horizontal components, are observed. In magnetic prospecting, measurements of the total vector are the exception rather than the rule; it is usually resolved into its horizontal and vertical components. Experience has shown that the vertical component exhibits the clearest relation between magnetic anomalies and disposition of geologic bodies, at least in northern and intermediate magnetic latitudes. Therefore, measurements of the magnetic vertical intensity are preferred and are supplemented occasionally by horizontal intensity observations for greater completeness in the evaluation of the anomalies.

Magnetic fields are generally expressed in **gauss.***; in magnetic exploration, it is more convenient to use 1/100,000 part of this unit, called the **gamma.** The accuracy requirements in magnetic prospecting are less than in gravity work; hence, it is a comparatively easy matter to design instruments suitable for magnetic exploration.

Anomalogic Factors

The magnetic anomalies of geologic bodies are dependent on their magnetic "susceptibility" and "remanent" magnetism, properties which vary much more widely than their densities. Rocks and rock formations fall into two natural groups: igneous rocks and iron ores are strongly magnetic, whereas sedimentary rocks are generally weak in magnetism. The magnetic characteristics of rocks are affected by numerous factors such as: the magnetic content, grain size, lightning, heat contact metamorphism, mechanical stress, disintegration and concentration, and also by structural forces which may alter the disposition of magnetic formations in the course of geologic periods.

*Flux density measured in lines of magnetic force per square centimeter (in air).

The magnetic method was first used in locating iron ores, but since the development of more sensitive instruments, it is being successfully applied to the discovery of non-magnetic ores through which small quantities of magnetite are distributed. Some of the newer magnetic instruments are indirectly useful in locating oil.

The Schmidt Magnetometers

Most widely used in magnetic prospecting are the Schmidt magnetometers. In the Schmidt vertical intensity magnetometer, a magnetic system is suspended on a knife-edge at right angles to the magnetic meridian; its center of gravity is so arranged that the system is approximately horizontal in the area under test. Deflections from this position are measured with a telescope and scale arrangement, expressed in scale divisions, and are then multiplied by a scale value to give relative vertical intensities.

In the Schmidt horizontal magnetometer, a magnetic system is suspended in the magnetic meridian and its center of gravity is so adjusted that the system stands approximately vertical in the area under survey and is deflected by the horizontal force. The methods of taking readings and applying corrections are the same as for the vertical magnetometers, except that for large anomalies of vertical intensity, a correction for vertical intensity variations is required.

The Hotchkiss Superdip

In the Hotchkiss superdip, a magnetized needle is suspended on a horizontal pivot and provided with a counter arm, so that both the position and the sensitivity of the needle may be controlled. The system may be used at right angles to the direction of the inclination, so that it will measure variations in total intensity.

The Dipneedle

The instruments described above furnish the high degree of accuracy required in oil exploration. In mining exploration, however, simpler devices are often quite satisfactory. The earliest instrument of this kind is the Swedish mining compass, in which a magnetic needle is suspended on a jewel and stirrup so that it can rotate about a horizontal and vertical axis. Another early instrument is the dial compass which is a combination of a compass and sundial. Extensive use has been made of the dipneedle, which is a magnetic needle capable of rotation about a horizontal axis and is essentially a vertical-intensity instrument.

General Method of Use

To give complete details on use of all these magnetic instruments would not only occupy this entire issue, but the entire issues for the year; so similar are the instruments that an explanation of the use of the dip needle will serve as a basic example of the employment of magnetic instruments in the field of exploratory geophysics.

While not quite as sophisticated and sensitive as its big brothers, the dipneedle is claimed, in proportion to its cost, to have saved more to prospectors in search of ore than any other invention.

In using the instrument, it is first carried over the surface of the ground, in a general north and south direction, until disturbances are noted. Parallel lines are then laid out a few feet apart, and the amount of attraction noted at intervals, and recorded on a map for future reference. The map will show variations in the vertical component of the magnetic field, and indicate the general location of disturbing factors. The amount of dip will be greater over the south magnetic pole of the ore body than over the north.

An ordinary compass may then be used to determine the values of the horizontal component, as indicated by variations of the needle from the true magnetic north. As soon as sufficient data has been obtained to construct a map showing the lines of equal declination and inclination, or curves of equal intensity of the vertical and horizontal components of the magnetic field, the location and extent of the ore body can be determined.

In taking readings with the dip needle, allowance must be made for variations due to fluctuating electrical conditions of the earth and atmosphere. The angle of declination should be known for the particular locality, since this angle varies from point to point over the earth's surface. A useful pamphlet entitled "The Magnetic Declination in the United States", showing the variations of all regions, may be obtained for ten cents from the Superintendent of Documents, Washington, D. C.

Of late years, the dip needle has become popular in the location of lost iron, such as manhole covers, pipe lines, etc., thus doing away with guess work and unnecessary excavating.

The instruments should always be held so that the needle can swing in a north and south direction, otherwise there is a tendency for the needle to bind at the bearings from the attraction of the earth's magnetic poles. When brought over an iron object of sufficient cross section,* one end of the needle dips downward from 1° to 90°, depending on the mass and nearness of the object. Sometimes when held directly over the center of a large iron object, the needle remains perfectly horizontal, and some operators may think the instrument is not working properly. The reason the needle does not dip is that the positive and negative poles of both the object and the needle are equally balanced, and the pull being the same on both ends of the needle, it cannot dip. If the instrument is now moved to the edge of the object, the balance is broken and the needle will dip.

*The cross section of a body is directly proportional to the integral effective area of the body presented to a plane which is parallel to the surface plant and inversely proportional to the square of the distance of the body from the instrument: C. S. equals Ae/D^2.

Care should be exercised in handling the instrument since the needle, being a small bar magnet, may become sufficiently demagnetized by rough treatment as to become useless for the more delicate work, or it may be ruined completely.

Magnetic instruments are simpler in construction and are easier to use than the gravitational devices, but to gather reliable data, one must become proficient in their employment by practice, and must, above all, have the knowledge and background both in physics and geology to be able to interpret accurately the data compiled. If this be yours, the door to successful prospecting by magnetic methods is open to you.

[To be continued]

[Reprinted in part from the Georgia Mineral Society News Letter.]

TEXAS PALEONTOLOGICAL EXPEDITION TO SEARCH FOR CRETACEOUS VERTEBRATES

The Texas Paleontological Expedition of the Chicago Natural History Museum left Chicago on April 3rd. Co-leaders are Bryan Patterson, curator of fossil mammals, and Dr. Rainer Zangerl, curator of fossil reptiles. The expedition is being conducted in cooperation with the Texas Memorial Museum of Austin. They will work in a large area surrounding the cities of Dallas and Fort Worth, located in the northern part of the eastern Cretaceous belt of Texas. The expedition has two main objectives: (1) a careful investigation of the Early Cretaceous Trinity Sands in Montague County, where a reconnaissance party of the museum discovered mammalian and frog remains last autumn, and (2) to search for similar deposits south of Montague County and for Late Cretaceous vertebrates mainly in the Eagle Ford Shale and the Taylor Marl (very few vertebrate localities are known in the latter formations). Investigation of the Late Cretaceous deposits in Texas presents a continuation of our program of faunal study of the southern so-called Gulf Series of deposits of late Cretaceous age. The expedition will remain in the field until about the middle of July.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*APPLIED SEDIMENTATION

Parker D. Trask, Editor. 1950. xii, 707 pp., 114 fig.; $5.00. (John Wiley & Sons, New York). A comprehensive handbook for geologists and engineers on the practical problems and economic applications of sedimentation. Recent or slightly consolidated sediments, ancient or maturely consolidated sediments (sedimentary rocks), and residual soils are considered in this symposium, prepared under the sponsorship of the Committee on Symposium on Sedimentation of the National Research Council. The 35 articles are grouped under seven topics: (1) basic principles of sedimentation, (2) engineering problems involving strength of sediments, (3) applications of processes of sedimentation, (4) applications involving nature of constituents, (5) economic mineral deposits, (6) petroleum geology problems, and (7) military applciations. Over 1000 references are given — a vauable aid to both the student and research worker.

MINERAL YEARBOOK — 1947

Allen F. Matthews, Editor. 1950. 1,593 pp.; $4.25. (U. S. Bureau of Mines; Supt. of Documents, Govt. Printing Office, Washington 25, D. C.), This Yearbook records the output, distribution and consumption of all known mineral commodities for the year 1947, the mineral industry's peak year of production. Various commodities are alphabetically arranged and comprise 64 chapters, including platinum, gold and other precious metals, gems, uranium, and petroleum products. In the section devoted to foreign minerals, special emphasis is given to the mineral industry of the Latin America countries.

BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY, 1948.

E. M. Thom, Marjorie Hooker, & R. R. Dunaven. 1950. iii, 309 pp.; $0.60. (U. S. G. S.; Supt. of Documents, Govt. Printing Office, Washington 25, D. C.). This bibliography lists publications on the geology, paleontology, petrology, and mineralogy of the continent of North America and adjacent islands, Panama, the Hawaiian Islands, and Guam. It also includes textbooks and general papers by American authors and those by foreign authors published in America.

*MAQUOKETA BRACHIOPODA OF IOWA.

Y. Wang. 1949. viii, 55 pp.; 12 pls.; $1.40. (Memoir 42, Geological Society of America, New York). This paper supplements H. S. Ladd's The Stratigraphy and Paleontology of the Maquoketa Shale of Iowa, part 1 (1929). Twenty-two genera and sixty species are described and discussed; six new genera are erected. The Maquoketa shale is an Upper Ordovician marine formation covering an area of nearly 700 square miles in the Mississippi valley and in northeastern Iowa.

*GRASSLAND HISTORICAL STUDIES:

Natural Resources Utilization in a Background of Science and Technology. Vol. I: Geology and Geography. James C. Malin. 1950. xii, 377 pp., 5 figs.; $2.50. (James C. Malin, Lawrence, Kansas). This historical study of the midwest includes a section on the development of geological discoveries and mapping in the 19th century. The book is concerned mainly with the early history of Kansas City, Missouri.

GEOLOGY OF HOLMES COUNTY (OHIO).

George W. White. 1949. 373 pp., 5 pls., 7 maps; $2.00. (Bulletin 47, Geoolgical Survey of Ohio, Columbus). This report includes the physiography of the area, stratigraphy, mineral resources; and a section on gas and oil by Raymond E. Lamborn. Stratigraphic sections are appended. Coal, clay, limestone, and sandstone, mainly from the Pennsylvanian Pottsville and Alleghany formations, are widely distributed over the area.

SHORT PAPERS ON GEOLOGIC SUBJECTS.

Illinois State Geological Survey. 1950. 23 pp., 9 figs.; free. (Circular 157, Ill. State Geol. Survey, Urbana). This booklet includes the following articles: Present State of Knowledge Regarding the Pre-Cambrian Crystallines of Illinois, by R. M. Grogan; Factors Affecting Measurement of Permeability of Unconsolidated Glacial Material, by R. D. Knodle; Facies Analysis of the Niagaran Rocks, by H. A. Lowenstam; and Physical Characteristics of the Oolite Grain of the Ste. Genevieve Formation, by R. S. Shrode.

STRUCTURAL GEOLOGY OF THE HAWTHORNE AND TONOPAH QUADRANGLES, NEVADA.

H. G. Ferguson & S. W. Muller. 1949. (1950). v, 55 pp., 15 pls., 10 figs.; $2.00. (U. S. G. S. Prof. Paper 216; Supt. of Documents, Govt. Printing Office, Washington 25, D. C.). Isolated mountain ranges of Paleozoic and Mesozoic rocks are separated by stretches of Tertiary and Quaternary rocks. This report treats mainly the geology of the pre-Tertiary rocks and the folding and thrusting occurring during the Jurassic.

PEGMATITE INVESTIGATIONS IN COLORADO, WYOMING, AND UTAH, 1942-44.

J. B. Hanley, E. W. Heinrich, & L. R. Page. 1950. vi, 125 pp., 17 pls., 34 figs.; $1.50. (U. S. G. S. Prof. Paper 227; Supt. of Documents, Govt. Printing Office, Washington 25, D. C.). The size, shape, and position of minable deposits in several pegmatites have been successfully predicted through structural and mineralogical studies. The pegmatites described are classified as beryllium, lithia, muscovite, columbium-tantalum, potash feldspar, or rare earth pegmatites. The geology, mineralogy, and reserves of the mines and prospects examined are described.

WATER RESOURCES

MARCH, 1950

The spring breakup started in the North Central states. Storms in late March increased the flow, and moderate floods resulted in eastern North Dakota, southern Minnesota, and Michigan. Prospects are that spring runoff will be well above normal throughout the region, for a good snow pack remains in most areas. Groundwater levels are generally favorable, and if snow melt is gradual, substantial accretions to groundwater storage may be expected.

Floods and high water persisted in parts of the eastern Texas-Alabama region, in contrast to the continued deficient runoff in the southern Atlantic Coastal Plains. The New York City water-supply situation improved substantially, and moderate floods occurred in upstate New York. Ground-water supplies in northern New England have improved, and are now near normal.

In the West, the flow of the Columbia River continued excessive — stream flow in the coastal areas of British Columbia, Washington, and Oregon was well above normal. The Colorado River was above normal, but surface-water supplies in central and southern California and in Arizona and New Mexico were notably deficient.

★ Another earth science contest, for boys and girls under 20 years of age in the United States and Canada who have not yet enrolled in a college or university, has been announced by the American Federation of Mineralogical Societies. The contest awards will include mineral specimens, books, magazine subscriptions, and other prizes to be announced. Articles on any earth science subjects are acceptable. The contest will end October 15, 1950. An official entry blank will be sent upon request to Prof. Richard M. Pearl, Colorado College, Colorado Springs, Colo.

★ The total gold production for Ontario during February 1950 was 195,574 ounces, valued at $7,672,499, the highest number of gold ounces since December 1942, except for the last three months of 1949. 34,513 ounces of silver are included in the above valuation. Quebec produced 90,450 ounces of gold and 335,030 ounces of silver during the same period.

★ The total value of minerals produced in California during 1949, as estimated by the Division of Mines, is $1,103,127,000. Petroleum accounted for $753,248,000 of the total; followed by natural gas gasoline; natural gas; cement, stone, sand and gravel; salines; clay products, liquefied petroleum gases; and gold.

★ Ward's Natural Science Establishment, Rochester, New York is now issuing a "perpetual catalog of fossils" — circulars issued at frequent intervals, offering stratigraphic collections, faunal groups, and fossil plants and shells.

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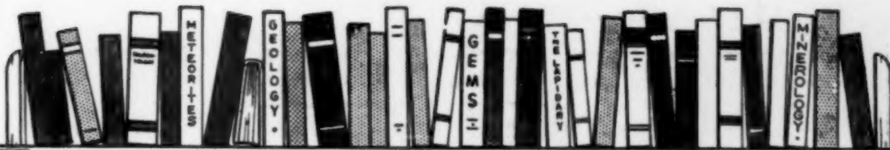

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